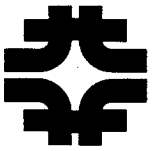

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# B VS. H CURVES FOR 1008 AND 1020 STEELS

A. Ito, W. Bosworth, A. T. Visser, J. Grimson, and W. Yang

July 1983

# B vs. H Curves for 1008 and 1020 Steels

A. Ito, W. Bosworth, A. Visser
J. Grimson, W. Yang

For the purpose of investigating the saturation regions, we have measured the B vs. H curves for the purchased 1008 and 1020 steels. In order to make a fair representation, the sample was chosen under the following conditions.

1) It was taken far away from the flame cutting region.

2) A hand saw was used to cut off the sample.

3) Finally the sample was machined into a toroidal shape of about 2" OD, 1.75" ID and 1/2" height.

We fabricated two samples of each type of steel in order to check the consistency of the measurements. The results are shown in Figs. 1 to 8.

For comparison, we plotted the curves on USS steel 1010 and 1020 respectively. As shown in Figs. 9 and 10, the measured curves are similar to that of hot rolled types of steel.

For convenience of the interested readers who want to run LINDA, TRIM or POISSON programs, we listed the values of B and H then computed values of $B^2$ and Gamma as shown in Tables 1 and 2. The samples were measured by Arnold Engineering, Marengo, IL.

We appreciate the technical assistance by J. Robb and L. Tung.

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Table 1

1008 Steel
7/1/83

| B (Kg) | H | $B^2$ ($\times 10^8$) | H ($\frac{\text{Amp-Turn}}{\text{meter}}$, $\times 10^2$) | $\gamma = \frac{1}{\mu} = \frac{H}{B}$ ($\times 10^{-4}$) |
|---|---|---|---|---|
| 0 | -0.1 | 0 | -.08 | - |
| 1.0 | 0.0 | .01 | 0.00 | - |
| 1.5 | 0.1 | .02 | .08 | .67 |
| 2 | 0.3 | .04 | .24 | 1.5 |
| 3 | 0.5 | .09 | .400 | 1.67 |
| 4 | 0.8 | .16 | .64 | 2. |
| 5 | 1.0 | .25 | .80 | 2. |
| 6 | 1.4 | .36 | 1.11 | 2.333 |
| 7 | 1.9 | .49 | 1.51 | 2.714 |
| 8 | 2.4 | .64 | 1.91 | 3.00 |
| 9 | 3.4 | .81 | 2.71 | 3.778 |
| 10 | 4.2 | 1.00 | 3.34 | 4.200 |
| 11 | 5.5 | 1.21 | 4.38 | 5.000 |
| 12 | 7.3 | 1.44 | 5.81 | 6.083 |
| 13 | 9.5 | 1.69 | 7.56 | 7.308 |
| 14 | 13.5 | 1.96 | 10.74 | 9.643 |
| 15 | 24.3 | 2.25 | 19.34 | 16.2 |
| 16 | 45.0 | 2.56 | 35.81 | 28.125 |
| 17 | 74.0 | 2.89 | 58.89 | 49.412 |
| 18 | 127.0 | 3.24 | 101.06 | 70.56 |
| 19 | 205.0 | 3.61 | 163.13 | 107.895 |

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Table 2

1020 Steel
7/1/83

| B (Kg) | H (oersted) | $B^2$ (x $10^8$) | $H\left(\frac{\text{Amp-Turn}}{\text{meter}}, \text{ x } 10^2\right)$ | $\gamma = \frac{1}{\mu} = \frac{H}{B}$ (x $10^-$ |
|---|---|---|---|---|
| 0 | 0 | 0 | 0.00 | - |
| 0.5 | 0.1 | .0025 | .08 | 2. |
| 1 | 0.2 | .01 | .16 | 2. |
| 2 | 0.4 | .04 | .32 | 2. |
| 3 | 0.6 | .09 | .48 | 2. |
| 4 | 0.8 | .16 | .64 | 2. |
| 5 | 1.1 | .25 | .88 | 2.2 |
| 6 | 1.5 | .36 | 1.19 | 2.5 |
| 7 | 2.0 | .49 | 1.59 | 2.857 |
| 8 | 2.6 | .64 | 2.07 | 3.25 |
| 9 | 3.6 | .81 | 2.86 | 4.00 |
| 10 | 4.6 | 1.00 | 3.66 | 4.6 |
| 11 | 6.2 | 1.21 | 4.93 | 5.636 |
| 12 | 8.2 | 1.44 | 6.53 | 6.833 |
| 13 | 11.5 | 1.69 | 9.15 | 8.846 |
| 14 | 17.0 | 1.96 | 13.53 | 12.143 |
| 15 | 28.8 | 2.25 | 22.92 | 19.2 |
| 16 | 47.0 | 2.56 | 37.40 | 29.375 |
| 17 | 86.0 | 2.89 | 68.44 | 50.588 |
| 18 | 138.0 | 3.24 | 109.82 | 76.667 |
| 19 | 215.0 | 3.61 | 171.09 | 113.158 |

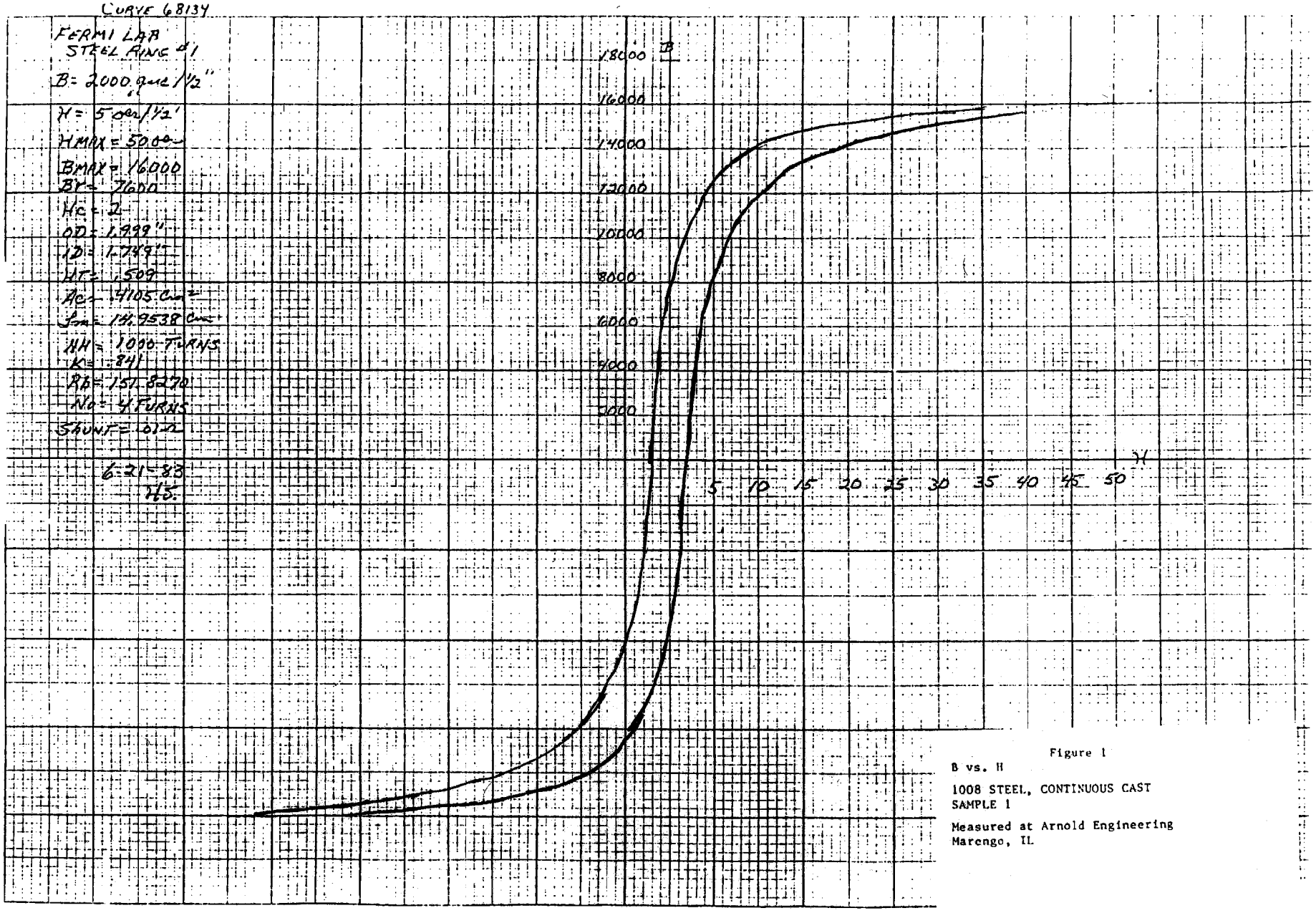
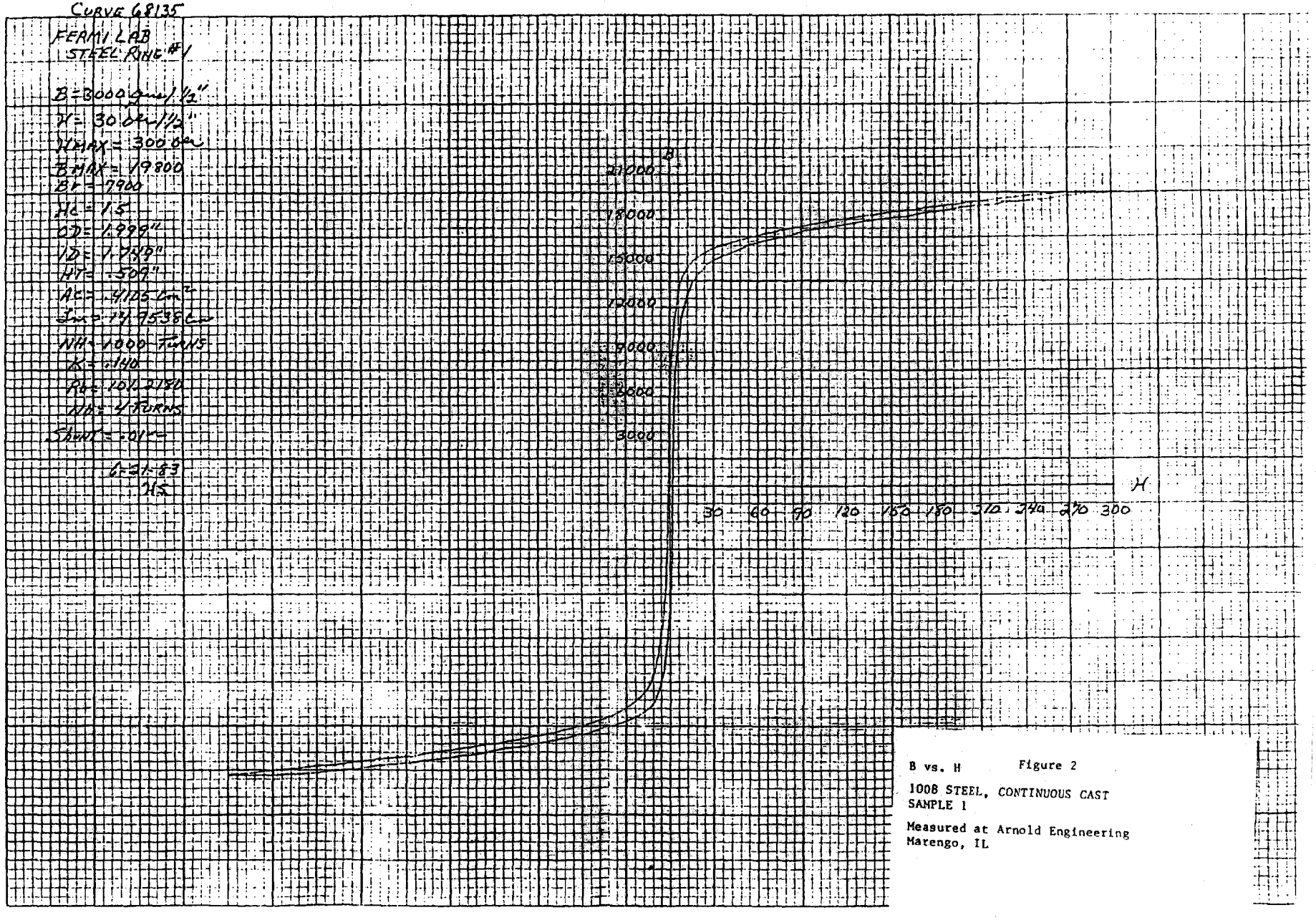



Figure 1

B vs. H

1008 STEEL, CONTINUOUS CAST
SAMPLE 1

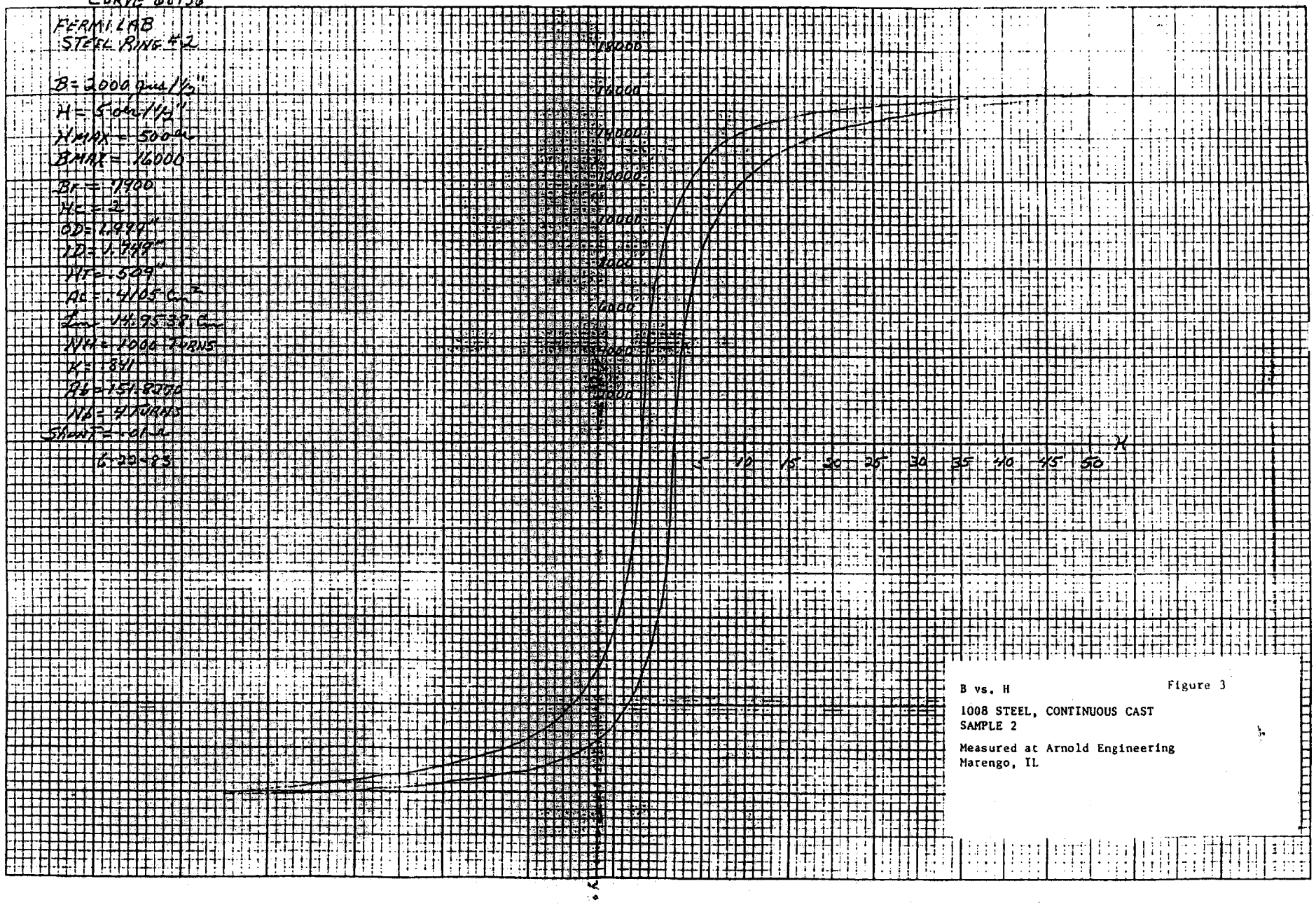
Measured at Arnold Engineering
Marengo, IL




B vs. H Figure 2

1008 STEEL, CONTINUOUS CAST
SAMPLE 1

Measured at Arnold Engineering
Marengo, IL


CURVE 68136
FERMILAB
STEEL RING #2
B=2000 gauss 1/2"
H=500e 1/2"
HMAX=500e
BMAX=16000
Br=7900
Hc=2
OD=2.999"
ID=1.749"
HT=.509"
AC=.4105 Cm²
Lm=14.9538 Cm
NH=1000 TURNS
K=.841
RL=151.8090
NB=1000 TURNS
SHUNT=.01Ω
6-20-83
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
5
10
15
20
25
30
35
40
45
50
H
B vs. H
Figure 3
1008 STEEL, CONTINUOUS CAST
SAMPLE 2
Measured at Arnold Engineering
Marengo, IL

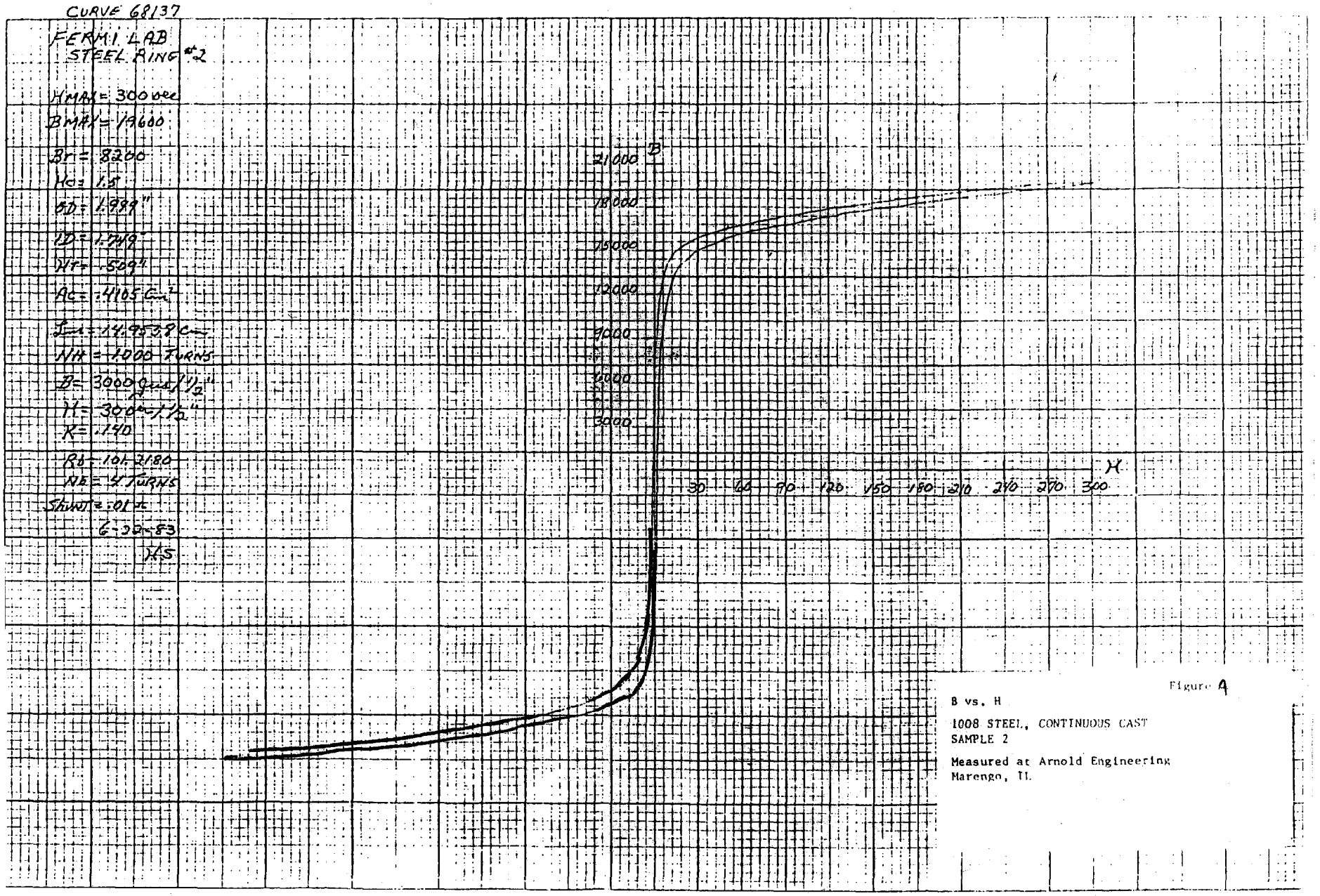



Figure 4

B vs. H

1008 STEEL, CONTINUOUS CAST
SAMPLE 2

Measured at Arnold Engineering
Marengo, IL

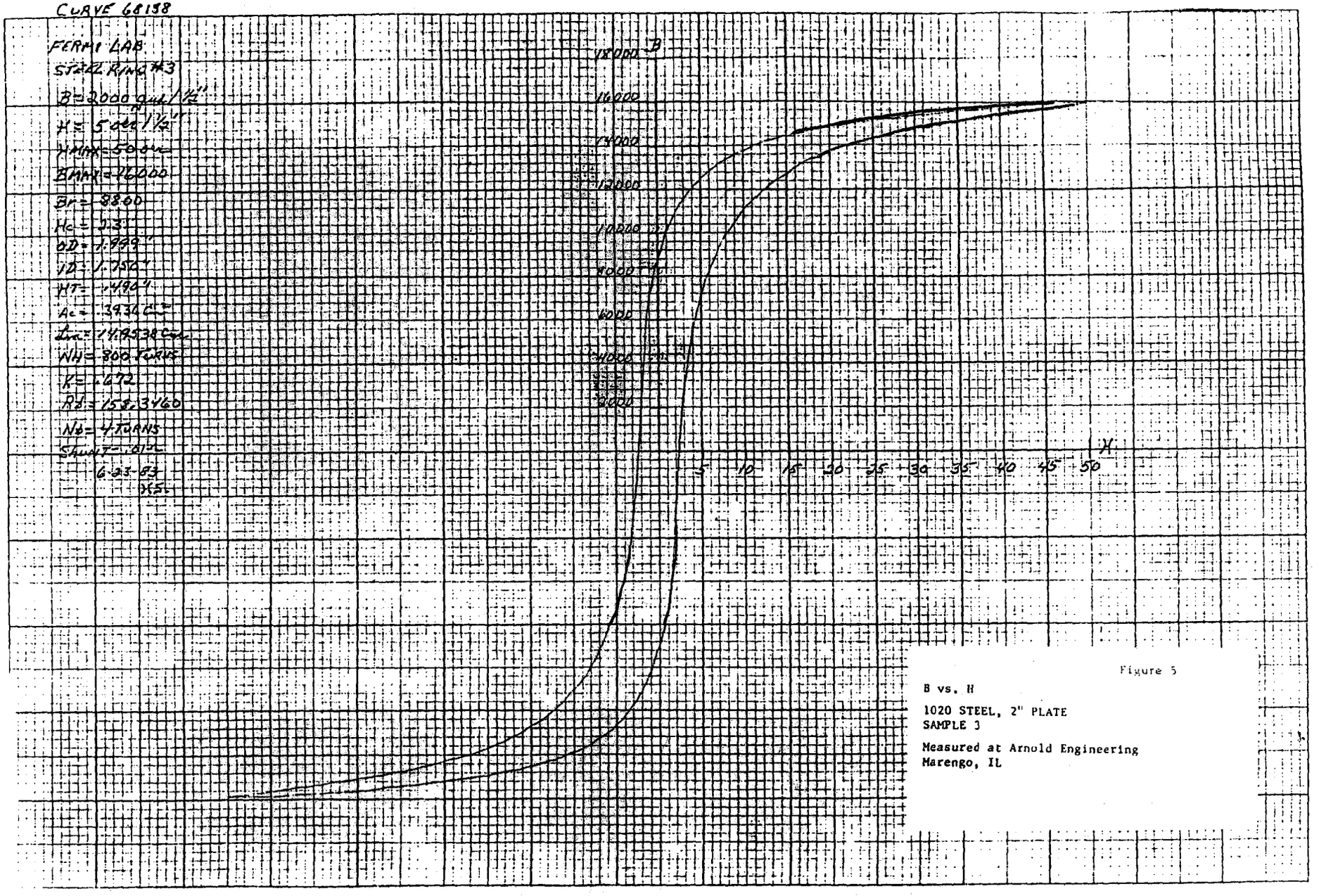



Figure 5

B vs. H

1020 STEEL, 2" PLATE
SAMPLE 3

Measured at Arnold Engineering
Marengo, IL

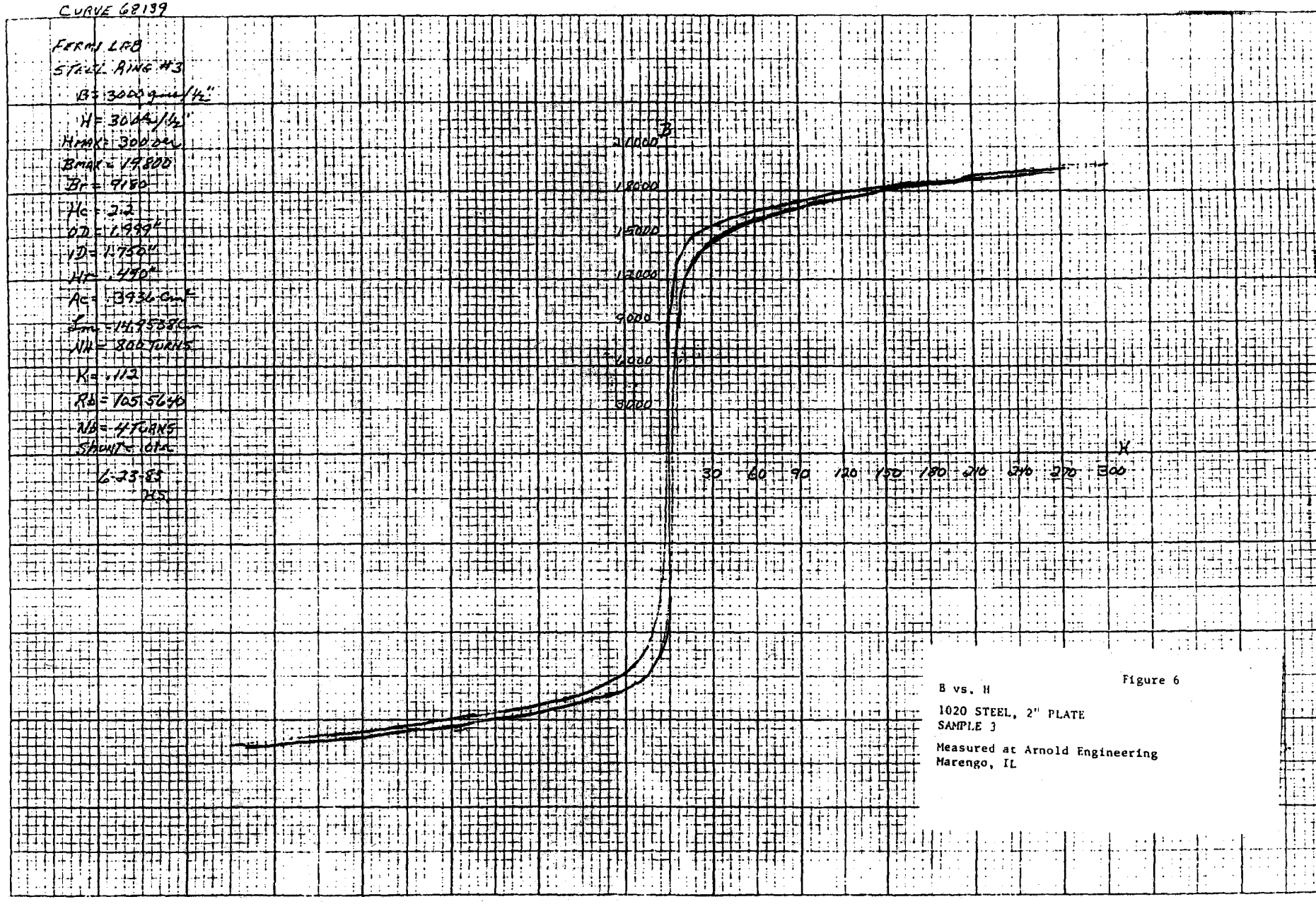



Figure 6

B vs. H

1020 STEEL, 2" PLATE
SAMPLE 3

Measured at Arnold Engineering
Marengo, IL

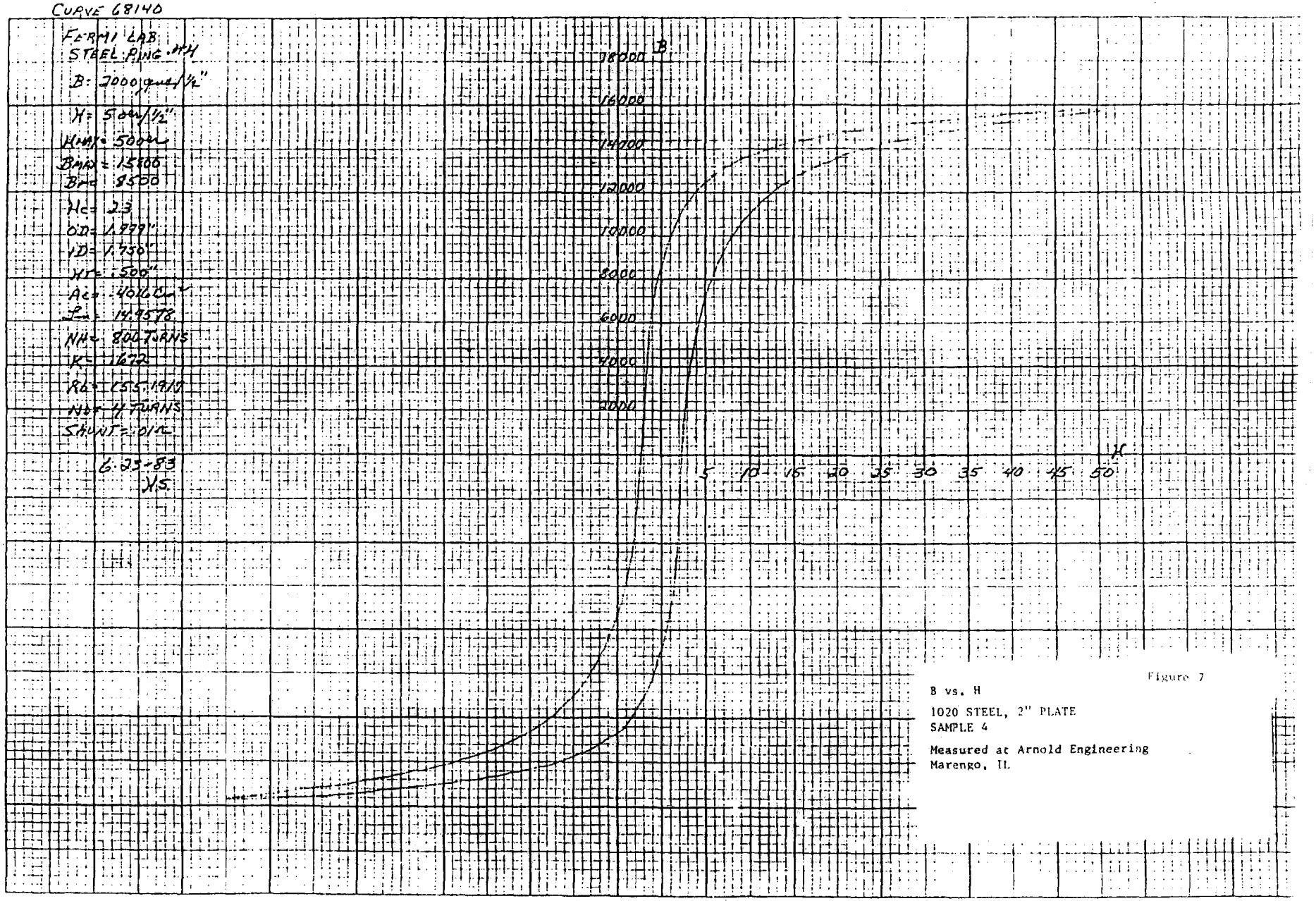



Figure 7

B vs. H

1020 STEEL, 2" PLATE
SAMPLE 4

Measured at Arnold Engineering
Marengo, IL

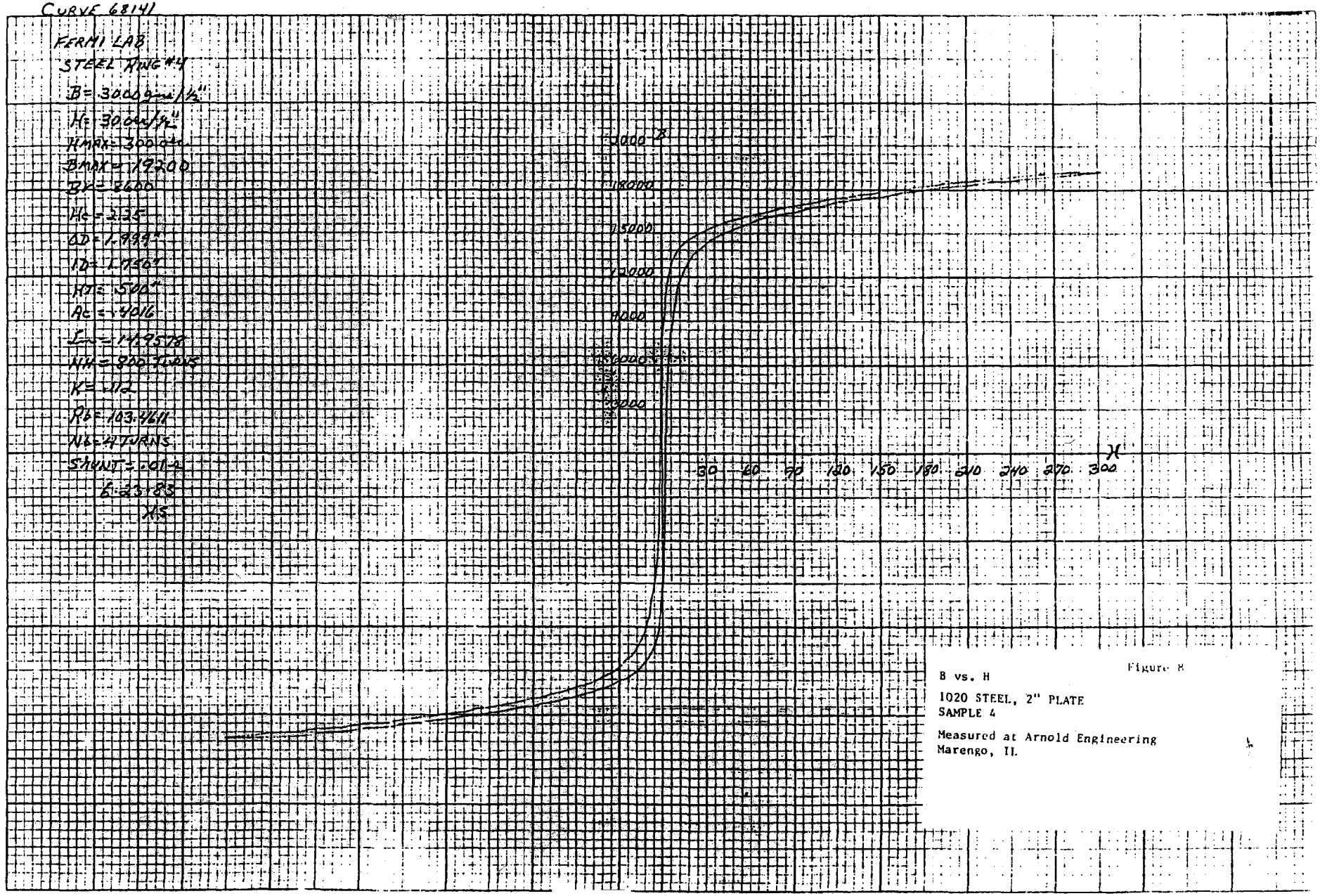



Figure 8

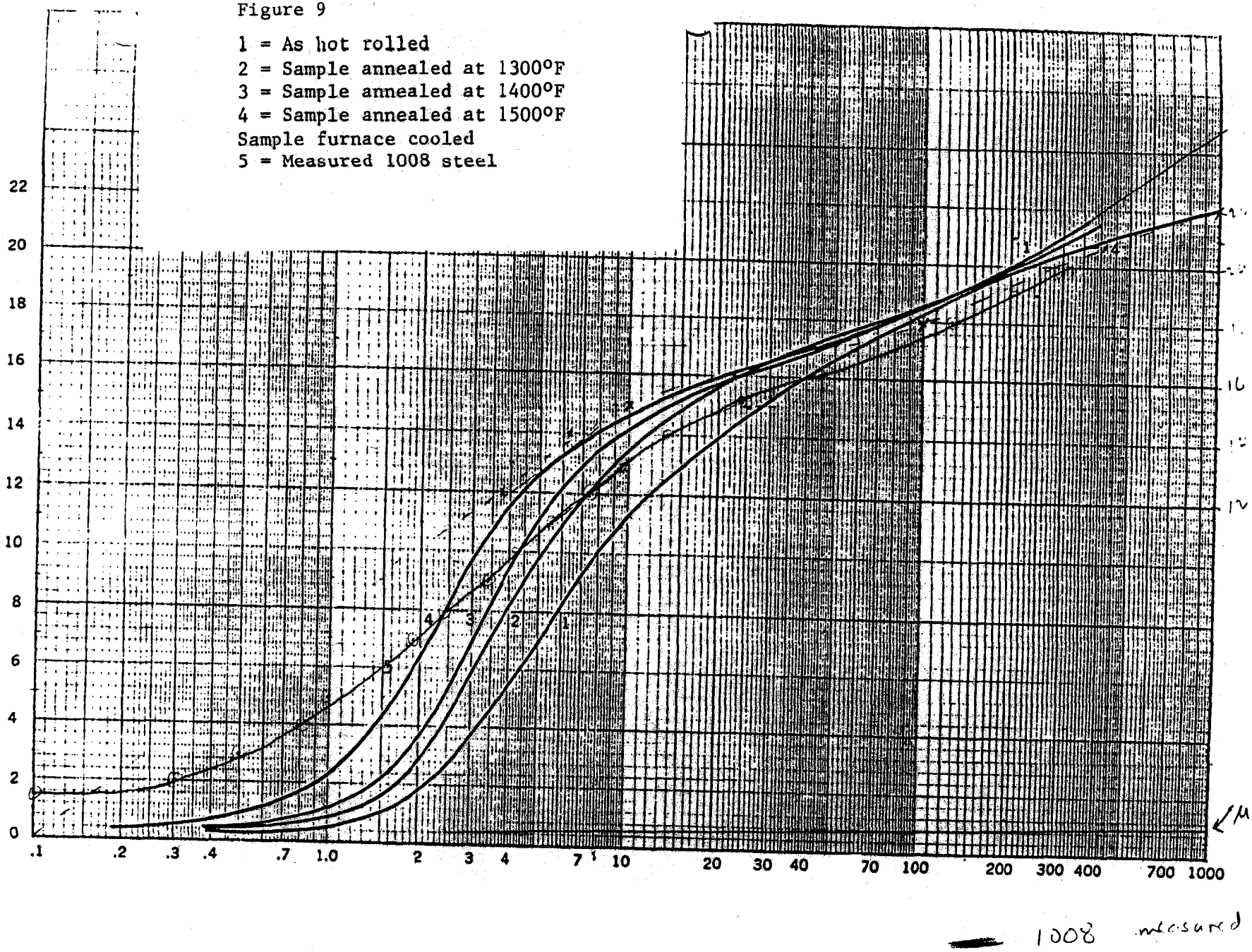
B vs. H

1020 STEEL, 2" PLATE
SAMPLE 4

Measured at Arnold Engineering
Marengo, IL

Figure 9

1 = As hot rolled
2 = Sample annealed at 1300°F
3 = Sample annealed at 1400°F
4 = Sample annealed at 1500°F
Sample furnace cooled
5 = Measured 1008 steel




USS

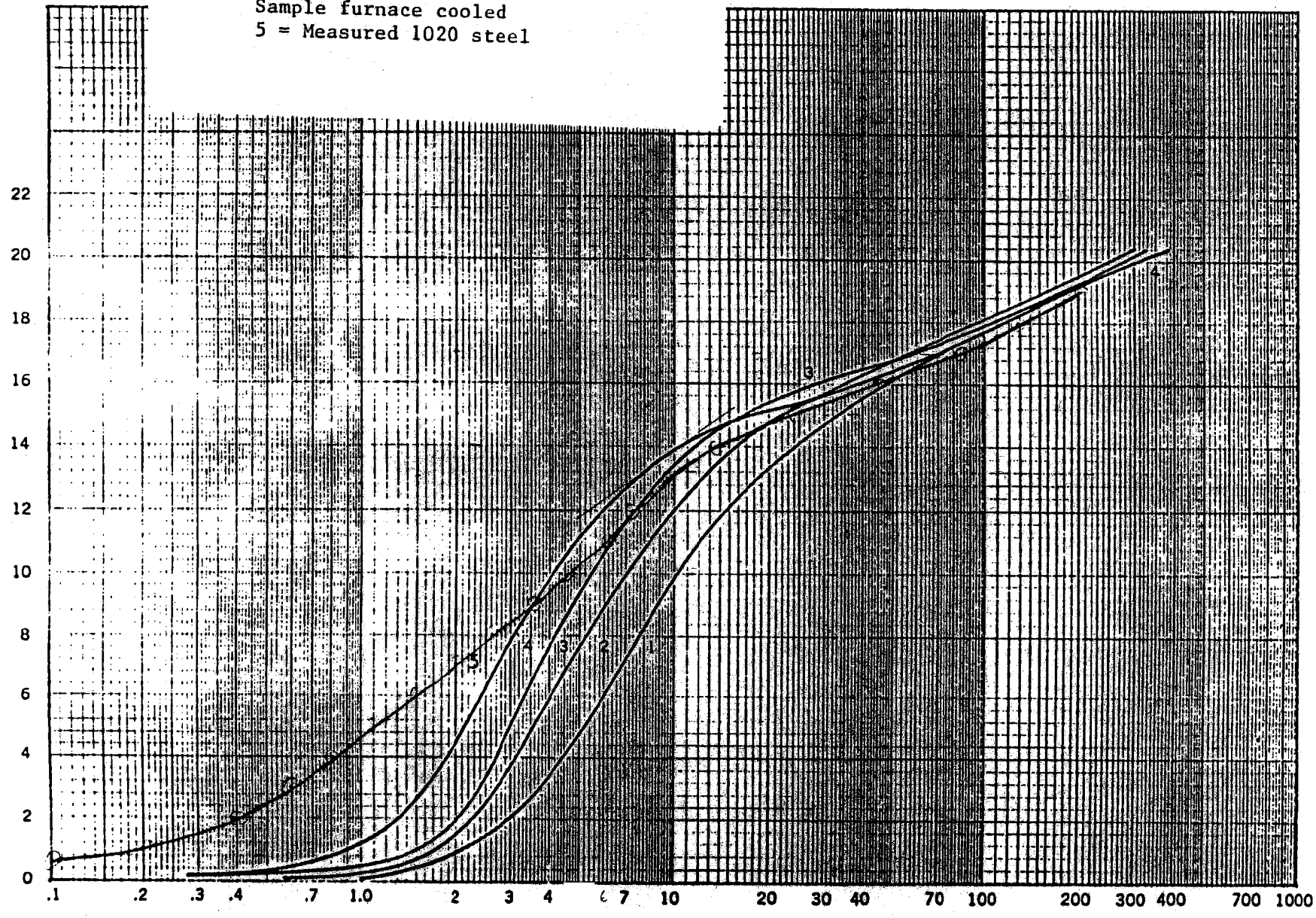
**Hot Rolled Carbon Steel Plates**
Grade 1010—Over .250 Inches
DC Magnetization

μ to aus

1008 measured

Figure 10

1 = As hot rolled
2 = Sample annealed at 1300°F
3 = Sample annealed at 1400°F
4 = Sample annealed at 1500°F
Sample furnace cooled
5 = Measured 1020 steel




USS Hot Rolled Carbon Steel Plates
Grade 1020—Over .250 Inches
DC Magnetization

1020 measured